CLAIMS

1. A method for forming semiconductor film single-crystal domains, the method comprising:

forming a substrate;

forming a single-crystal seed overlying the substrate;

forming an amorphous film overlying the seed;

annealing the amorphous film; and,

forming a single-crystal domain in the film responsive to the single-crystal seed.

2. The method of claim 1 wherein forming an amorphous film overlying the seed includes forming a film from a material selected from the group including silicon and silicon-germanium.

3. The method of claim 2 wherein annealing the amorphous film includes annealing with a process selected from the group including laser annealing, laser induced lateral growth (LiLAC), and furnace annealing.

4. The method of claim 3 wherein forming a substrate includes forming a substrate from a material selected from the group including glass, plastic, metal, and silicon.

5. The method of claim 4 further comprising

prior to forming the single-crystal seed, forming an insulator film overlying the substrate.

6. The method of claim 5 wherein forming an insulator film overlying the substrate includes forming the insulator layer from a material selected from the group including SiO2, SiNx, and combinations of SiO2 and SiNx.

7. The method of claim 6 wherein forming a single-crystal seed overlying the substrate includes forming a seed selected from the group including a nanowire and a self assembled monolayer (SAM).

8. The method of claim 7 wherein forming a single-crystal seed includes forming a single-crystal seed having a crystallographic orientation selected from the group including <110> and <100>.

9. The method of claim 6 wherein forming a single-crystal seed includes forming a nanowire having a diameter in the range of 2 to 50 nanometers and a length in the range of 10 to 1000 microns.

10. The method of claim 7 wherein forming a single-crystal seed includes forming a plurality of seeds overlying the substrate; and,

wherein forming a single-crystal domain in the film responsive to the seed includes forming a plurality of single-crystal domains, each domain responsive to a corresponding seed.

11. The method of claim 6 wherein annealing the amorphous film includes annealing using the LiLAC process with a beamlet width less than 20 microns.

12. The method of claim 11 wherein annealing the amorphous film includes annealing using the LiLAC process with a beamlet width less than 10 microns.

13. The method of claim 7 wherein forming a single-crystal seed includes forming a nanowire with a first length; and,

wherein annealing the amorphous film includes annealing using the LiLAC process with a beamlet length greater than the first length.

14. The method of claim 7 wherein forming a single-crystal seed includes forming a plurality of single-crystal seeds; and,

wherein annealing the amorphous film includes annealing using the LiLAC process with a beamlet length sufficient to simultaneously irradiate a plurality of seeds.

15. The method of claim 7 wherein annealing the amorphous film using the LiLAC process includes step-and-repeat annealing in a first direction; and,

wherein forming a single-crystal domain in the film includes forming a single-crystal domain laterally grown in the first direction, having a length of greater than 50 microns.

16. The method of claim 15 wherein forming a single-crystal domain in the film includes forming a single-crystal domain laterally grown in the first direction, having a length of greater than 100 microns.

17. The method of claim 7 wherein forming a single-crystal seed overlying the substrate includes depositing the single-crystal seed overlying a selected area of the substrate.

18. The method of claim 17 wherein depositing the single-crystal seed overlying a selected area of the substrate includes:

depositing a plurality of seeds overlying the substrate;

forming a mask over the selected area of the substrate; and,

etching the seeds from the unmasked areas.

19. The method of claim 7 wherein forming a single-crystal seed includes depositing a plurality of single-crystal seeds overlying the substrate, including a first seed, overlying a first area of the substrate; and,

wherein forming a single-crystal domain includes:

forming the single-crystal domain in response to annealing the first seed; and,

recrystallizing the plurality of seeds in the crystallographic orientation of the first seed.

20. The method of claim 17 wherein forming a single-crystal seed overlying the substrate includes depositing a nanowire having a length in a first direction with respect to the underlying substrate.

21. The method of claim 10 wherein forming an amorphous film overlying the seed includes forming an amorphous Si film; and,

the method further comprising:

forming a plurality of pixel areas, each pixel area corresponding to the plurality of single-crystal domains.

22. The method of claim 7 wherein forming an amorphous film overlying the seed includes forming an amorphous Si film; and,

the method further comprising:

forming a liquid crystal display (LCD) pixel area in the single-crystal domain.

23. The method of claim 7 wherein forming an amorphous film overlying the seed includes forming an amorphous Si film; and,

the method further comprising:

forming thin-film transistors (TFTs) in the single-crystal domain.

24. The method of claim 23 wherein forming a single-crystal seed includes forming a seed with a <100> crystallographic orientation; and,

wherein forming TFTs in the single-crystal domain includes forming an n-type TFT.

25. The method of claim 23 wherein forming a single-crystal seed includes forming a seed with a <110> crystallographic orientation; and,

wherein forming TFTs in the single-crystal domain includes forming a p-type TFT.

26. A semiconductor structure with lateral single-crystal domains, the structure comprising:

a substrate;

a first single-crystal seed having a location overlying the substrate;

a semiconductor film overlying the substrate and the first single-crystal seed, selected from the group of materials including silicon (Si) and silicon germanium, the semiconductor film including a single-crystal domain extending laterally from the first single-crystal seed location.

27. The structure of claim 26 wherein the substrate is a material selected from the group including glass, metal, plastic, and silicon.

28. The structure of claim 26 further comprising:

an insulator film overlying the substrate and underlying the single-crystal seed, formed from a material selected from the group including SiO2, SiNx, and combinations of SiO2 and SiNx.

29. The structure of claim 26 wherein the first single-crystal seed is a material selected from the group including a nanowire (NW) and a self assembled monolayer (SAM).

30. The structure of claim 26 wherein the first single-crystal seed has a crystallographic orientation selected from the group including <110> and <100>; and,

wherein the single-crystal domain has a crystallographic orientation that matches the first single-crystal seed.

31. The structure of claim 26 wherein the first single-crystal seed has a diameter in the range of 2 to 50 nanometers and a length in the range of 10 to 1000 microns.

32. The structure of claim 31 wherein the single-crystal domain has a width that is greater than, or equal to the length of the first single-seed crystal.

33. The structure of claim 30 further comprising:

a plurality of seed crystals overlying the substrate and underlying the single-crystal domain of the semiconductor film, having the same crystallographic orientation as the first single-seed crystal.

34. The structure of claim 26 wherein the single-crystal domain has a length greater than 50 microns.

35. The structure of claim 34 wherein the single-crystal domain has a length greater than 100 microns.

36. The structure of claim 26 further comprising:

a first plurality of single-crystal seeds overlying the substrate in a first plurality of locations; and,

a first plurality of single-crystal domains, each single-crystal domain laterally extending from a corresponding single-crystal seed location.

37. A single-crystal thin-film transistor (TFT), the TFT comprising:

a substrate;

a first single-crystal seed having a location overlying the substrate;

a semiconductor film overlying the substrate and single-crystal seed, selected from the group of materials including silicon (Si) and silicon germanium, the semiconductor film including a single-crystal domain extending laterally from the first single-crystal seed location;

a TFT channel, source, and drain region formed in the single-crystal domain;

a gate oxide layer overlying the channel; and,

a gate overlying the gate oxide layer.

38. The TFT of claim 37 wherein the first single-crystal seed and the single-crystal domain have a <100> crystallographic orientation;

wherein the source and drain are n+ doped.

39. The TFT of claim 37 wherein the first single-crystal seed and the single-crystal domain have a <110> crystallographic orientation;

wherein the source and drain are p+ doped.

40. The TFT of claim 37 further comprising:

a plurality of single-crystal seeds, each having a location overlying the substrate;

a plurality single-crystal domains, each extending laterally from a corresponding single-crystal seed location;

a TFT channel, source, and drain region formed in each single-crystal domain;

a gate oxide layer overlying each channel; and,

a gate overlying each gate oxide layer.

41. The TFT of claim 37 further comprising:

a plurality of TFT channel, source, and drain regions formed in the single-crystal domain;

a gate oxide layer overlying each channel; and,

a gate overlying each gate oxide layer.

42. The TFT of claim 37 wherein the substrate is a material selected from the group including glass, metal, plastic, and silicon.

43. The TFT of claim 37 further comprising:

an insulator film overlying the substrate and underlying the first single-crystal seed, formed from a material selected from the group including SiO2, SiNx, and combinations of SiO2 and SiNx.

44. The TFT of claim 37 wherein the first single-crystal seed is a material selected from the group including a nanowire (NW) and a self assembled monolayer (SAM).

45. The TFT of claim 37 wherein the first single-crystal seed has a crystallographic orientation selected from the group including <110> and <100>; and,

wherein the single-crystal domain has a crystallographic orientation that matches the first single-crystal seed.

46. The TFT of claim 37 wherein the first single-crystal seed has a diameter in the range of 2 to 50 nanometers and a length in the range of 10 to 1000 microns.

47. The TFT of claim 46 wherein the single-crystal domain has a width that is greater than, or equal to the length of the first single-seed crystal.

48. The TFT of claim 45 further comprising:

a plurality of seed crystals overlying the substrate and underlying the single-crystal domain of the semiconductor film, having the same crystallographic orientation as the first single-seed crystal.

49. The TFT of claim 37 wherein the single-crystal domain has a length greater than 50 microns.

50. The TFT of claim 49 wherein the single-crystal domain has a length greater than 100 microns.